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(12) # EUROPEAN PATENT APPLICATION

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(71) Applicant: CONCENTRIC PUMPS LIMITED
Unit 10 Gravelly Industrial Park Tyburn Road Erdington
Birmingham B24 8HW(GB)

(72) Inventor: Child, Robin Edward
Apple Tree Cottage Hunscote Lane
Wellesbourne Warwickshire CV35 9EX(GB)

(74) Representative: Hands, Horace Geoffrey et al,
GEORGE FUERY & CO Whitehall Chambers 23 Colmore Row
Birmingham B3 2BL(GB)

(54) **Variable output internal gear pump.**

(57) A variable ouput gerotor pump has a rotor (12) with *n* lobes meshed with a pair of juxtaposed annuli (16,18) of *n+1* lobes and these are arranged to be turned in opposite directions to take the annuli lobes out of alignment and reduce the output volume of the pump. In the arrangement illustrated in Figure 1, the annuli are turned in opposite directions by eccentric rings (20,22) arranged as gear rings, meshed with a common pinion (24), rack displaced by a piston (34) exposed to pump pressure.

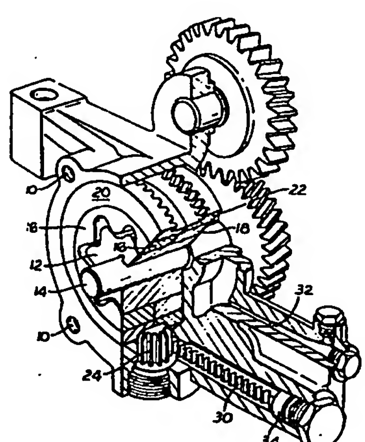

Fig 1

EP 0 076 033 A1

TITLE MODIFIED
see front page

DESCRIPTION

PUMPS

This invention relates to oil pumps for internal combustion engines.

The output requirement from an oil pump is maximum when the engine is at maximum speed/load. It is customary to design an oil pump to deliver the required lubricant flow under such conditions, and then when the engine is idling, the pump output is probably too great, and the surplus lubricant is returned to the oil sump by means of some vent, presure relief valve or the like. Inevitably this means that the pump wastes energy.

In the past, there was a low awareness of energy absorbtion with internal combustion engine arrangements, and small losses were considered to be unimportant. With increasing fuel costs and exhaustion of fossil fuel resources, there is a much greater awareness, and it is or may now be economical to produce special designs of oil pumps which at least reduce power wastage.

The object of the present invention is to provide such an oil pump.

In accordance with the present invention, a gerotor pump of the n and n+1 kind comprises a rotor common to at least a pair of axially juxtaposed annuli, and the annuli being located in individual and corresponding eccentric mounting rings, and means being provided for turning said rings in opposite directions whereby the effective size of the pumping chambers provided between the respective lobes of the rotor and annuli may be varied.

In the situation where the annuli and rings are wholly aligned so that their axes are co-axial, the pumping chambers will be of a maximum effective size. Where one of the rings is turned relative to the other, for example by making it in the fashion of a known reversing ring and turning it to the reversed position, a maximum size chamber between the one annulus and the rotor will be aligned with a minimum size chamber between the other annulus and the rotor. This not only reduces the volume of the chamber, but because the reverse situation will apply at a different points around the gyratory path, it will mean that the pumping effect will be substantially reduced.

However, it has been found if one annuli is in fixed and invariable position (relative to the inlet and outlet ports) and the other annuli is turned, e.g. towards the reverse position, that whilst the chamber volumes are varied and the theoretical pumping output is reduced, there are undesirable side effects. These are in the nature of noise during running of the pump, and it is anticipated that the noise is indicative of unsatisfactory pressure conditions within the pump which are likely to cause wear or damage if allowed to continue.

In a simple gerotor pump with a single annulus, a series of chambers exist between the respective lobes, and these chambers increase in volume from a minimum to a maximum and then return to that minimum as the parts turn. The inlet and outlet ports are located so that oil is drawn in by the increasing volume of the chambers and expelled by the decreasing volume of the chambers. If the ports were not appropriately situated, reducing volume of the chambers will not be associated with

an outlet port and because the oil is effectively incompressible, the trapped oil in the chamber causes the noise referred to. It will be seen that by turning one ring relative to the other, so that half the axial length of each chamber is as described but the other half follows a different pattern because of the turning, there is the possibility that some oil entrapment may occur. It is for this reason that the invention is restricted to the requirement that the annuli are to be turned in opposite directions with the intention of effectively cancelling out such an undesirable effect.

However, it is not considered essential that the annuli are to be turned to equal distances in opposite directions, and some variation can be obtained by appropriate length of inlet and outlet ports, and some degree of entrapment is acceptable.

In experimental conditions, it has been found that by turning the two annuli through equal angle to a maximum, substantial reductions in flow rate and in torque - and hence energy absorbtion are possible.

In a preferred arrangement a variable volume oil pump for an i.c. engine has the two rings coupled together for movement in opposite directions. This may be done automatically and proportionally (within limits) to engine speed and load, and one way of achieving this, for example, is by the use of governor devices, in a manner analogous to that employed with automatic advance/retard mechanisms for i.c. ignition systems.

The invention is now more particularly described

with reference to the accompanying drawings wherein:-

Figure 1 is a part sectional perspective view of a variable displacement pump according to the invention;

Figure 2 is an enlarged sectional elevation of the same in a maximum volume position; and

Figure 3 is a view similar to Figure 2 but showing the same in a reduced volume delivery position.

Turning now to Figure 1, the gerotor pump is there illustrated with a cover, normally held in place by screws engaged in holes 10, removed to reveal the rotors and pumping chambers. The inner rotor 12 has n lobes and is fast with drive shaft 14. The rotor 12 extends over the full width of two annuli 16 18 which are like, and each has n+1 lobes. Each of the rotors 16 18 is eccentric to the shaft 14 axis, and lies in a corresponding eccentric ring 20 22. When the eccentric rings are aligned then annuli 16 18 are aligned and an end elevation will appear as in Figure 2.

The eccentric rings 20 22 are provided with gear teeth and both sets of teeth are meshed with a common pinion 24, and when that pinion is rotated about its axis, the two eccentric rings are turned in opposite directions and hence shift the respective positions of the annuli 16 18. Figure 3 shows the parts in a shifted position.

The position of the inlet and outlet ports is shown in Figures 2 and 3 with the reference numerals 26 28. Effectively, it is the progression past the inlet port of a series of interlobe chambers which increase in volume as they pass the port which induces pumping flow from the inlet port into those chambers, and likewise it is the progression

of those chambers past the outlet port whilst the chambers are decreasing in volume which causes the pumping flow through the outlet port. The total volume of the chambers as well as the rate of change of volume affects the pumping rate. It will be seen by comparison of figures 2 and 3 that in Figure 3 the chambers are effectively of smaller volume because of the relative displacement of the annuli and hence the volume pumped is reduced.

The pinion 24 is arranged to be rotated, in this embodiment, by a rack 30 which may be driven by pressure derived from any of a number of different places in the pump or in the engine (for example) to which the pump is fitted. The pinion is preferably urged by a torsion spring so that when pressure falls the pinion automatically reverses its direction and returns the annuli towards the aligned position. Figure 1 illustrates an arrangement in which pressure in the outlet port of the pump itself is connected via passage 32 and by way of a filter to act on piston 34 for displacing the rack 30. If a comparatively external pressure source is to be utilised, the passage 32 may be blocked.

CLAIMS

1. A gerotor pump of the n and n+1 kind comprises a rotor common to at least a pair of axially juxtaposed annuli, and the annuli being located in individual and corresponding eccentric mounting rings, and means being provided for turning said rings in opposite directions whereby the effective size of the pumping chambers provided between the respective lobes of the rotor and annuli may be varied.

2. A pump as claimed in Claim 1 wherein eccentric mounting rings are formed as gear rings and meshed with a common pinion.

3. A pump as claimed in Claim 2 wherein the pinion is spring returned and meshed with a rack for turning the same.

4. A pump as claimed in any preceding claim wherein the rack is arranged to be displaced by a piston exposed to pump output pressure.

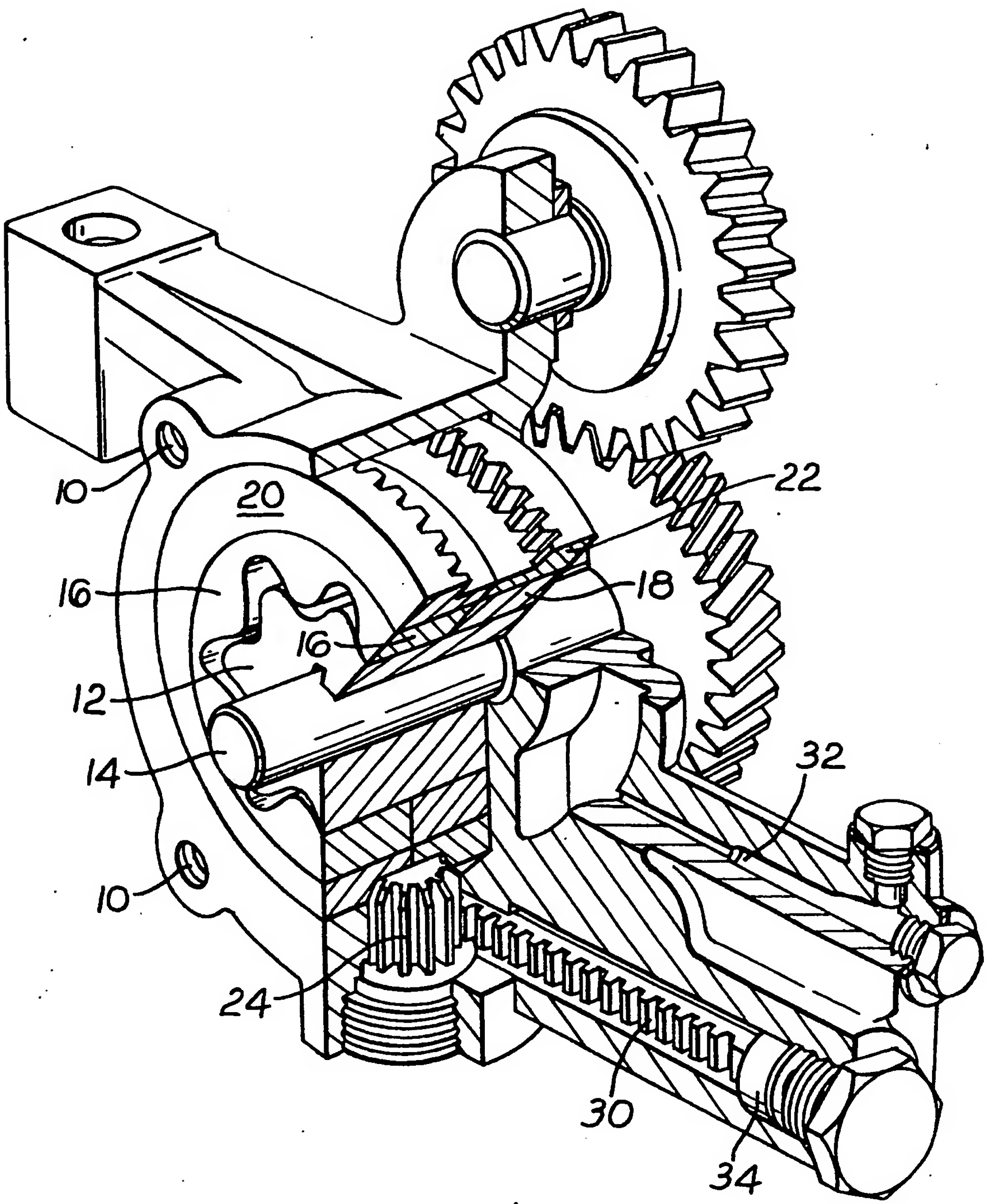

Fig. 1

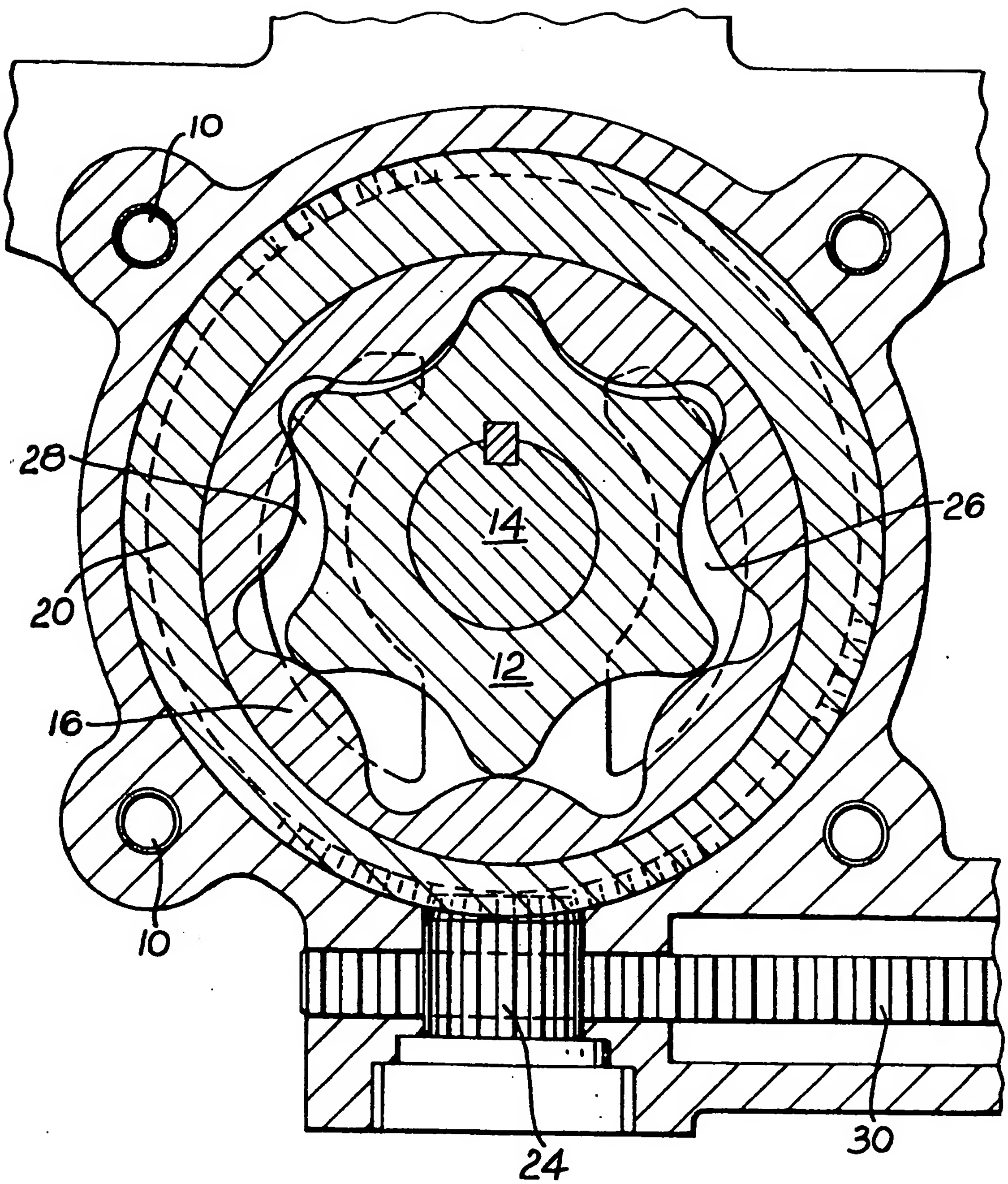

Fig. 2

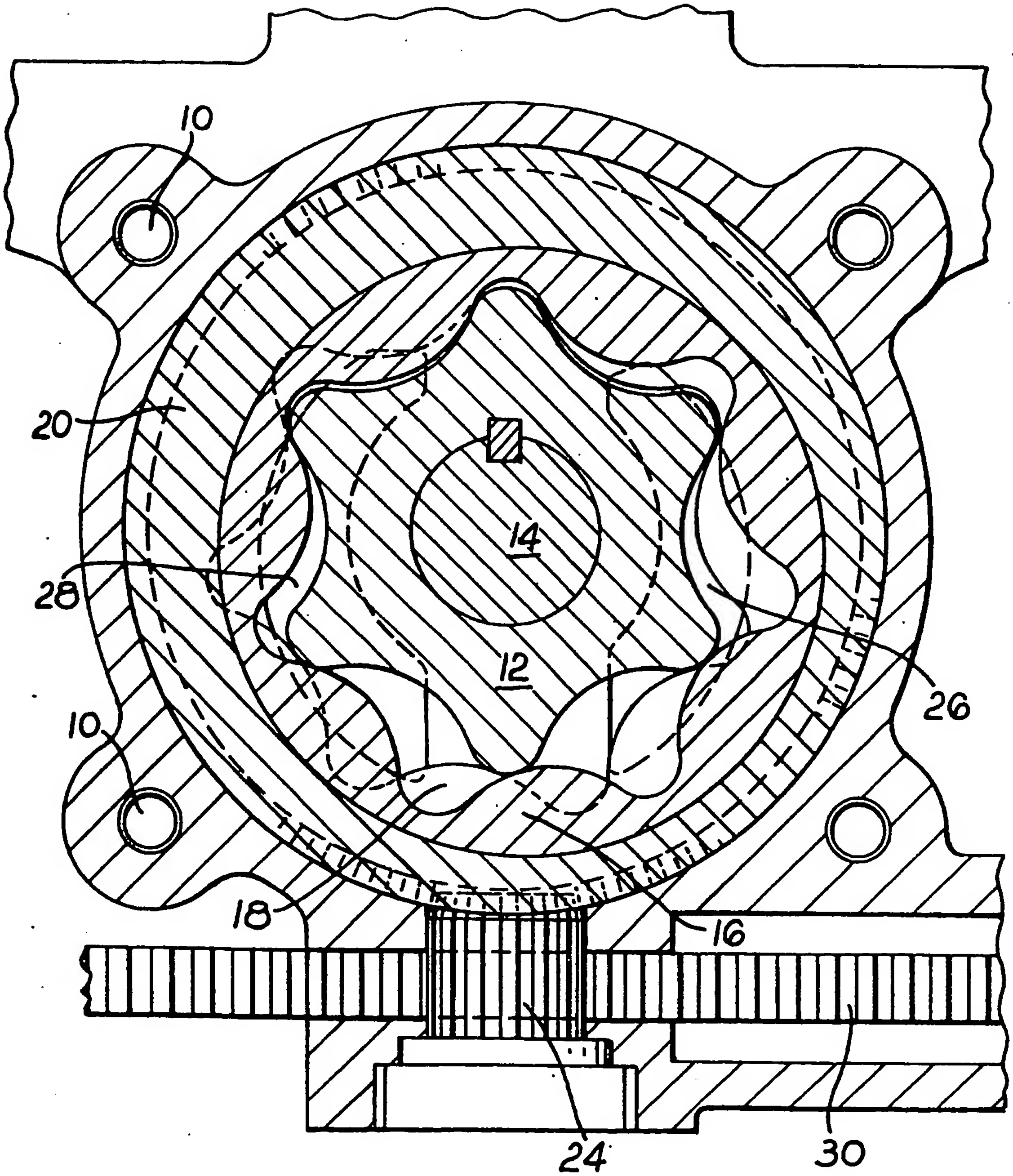

Fig. 3

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EUROPEAN SEARCH REPORT

0076033
Application number

EP 82 30 4423

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Y	FR-A-1 171 379 (PATIN) *Page 2, right-hand column, paragraph before last and last line; page 3, left-hand column, two first paragraphs; figures 4,5*	1	F 04 C 2/10 F 04 C 15/04
Y	GB-A- 628 084 (VICKERS) *Page 2, lines 89 to 109; page 3, lines 29 to 97; figure 1*	1,2	
A	DE-B-1 231 563 (DANFOSS) *Column 4, line 29 to the end; column 5, first paragraph; figures 3,4,5*	1,4	
A	GB-A-1 426 223 (CONCENTRIC PUMPS)		TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
A	GB-A- 896 393 (BRUNDAGE)		F 04 C F 01 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13-12-1982	KAPOULAS T.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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